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CHAPTER 7

What Are Intentions?

Elisabeth Pacherie and Patrick Haggard

INTRODUCTION

Neuroscientific work on intentions and voluntary actions has tended to focus on very short time scales, immediately before movement onset. As a prime example, the intentions investigated by Benjamin Libet are states that are first consciously experienced on average 200 ms before action onset. Libet's experiments showed that these conscious intentions were reliably preceded by a few hundred milliseconds by a negative brain potential, the so-called readiness potential. The existence of this antecedent unconscious brain activity indicated that the action was initiated unconsciously rather than by the conscious intention. This led Libet to the conclusion that we do not have full-blown "free will." However, he attempted to salvage a limited form of free will by suggesting that although we cannot consciously initiate actions, we can still consciously veto them in the 200 ms interval between conscious intention and action onset. Libet's conception of free will and his interpretation of his results have been widely discussed and criticized.

Here, we take as our starting point one of these lines of criticism, voiced notably by Shaun Gallagher (2006). Gallagher argues that it is misguided to attempt to frame the question of free will at the time scale and in terms of the very short-term motor intentions and control processes Libet considers. Rather, free will involves temporally extended deliberative processes and applies to intentional actions considered at levels of description typically higher and more abstract

than descriptions in terms of motor processes and bodily movements. In earlier work, one of us (Pacherie, 2008) proposed a three-tiered hierarchical model of intentions, the DPM model, distinguishing distal or prospective intentions, proximal or immediate intentions, and motor intentions; the other (Haggard, 2008) offered a naturalized model of human volition involving a set of decision-making processes concerned with whether to act, what to do (and how), and when to act. If Gallagher is right about the temporal and intentional framework relevant for the exercise of free will, a discussion of free will must at least include not only the contribution of intentions to the final process of action initiation itself, but also the anterior decision processes that take place at the level of prospective intentions.

1. IMMEDIATE INTENTION AND ACTION INITIATION

Providing a satisfactory definition of intention is notoriously difficult. In this chapter, we assume that intention is a mental state, which may be associated with particular brain states. But what *kind* of mental state is an intention? We suggest that intentions have two distinguishing features. First, they are accessible to consciousness. Second, they bear some relation to subsequent action. This relation could be distinctive for two reasons: a causal reason or a content reason. Let us take a physical movement of the body (I raise my arm) as a paradigm of action. The causal reason suggests that the intention (I intend to raise my arm) is simply the mental state that

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1 causes the action of lifting my arm (Wittgenstein,
2 1953). Intentions thus explain why actions occur,
3 and serve as the guarantors of volition. This view
4 is clearly vulnerable to skeptical attack: folk
5 psychology may find it convenient to have some
6 appropriate explanation of a person's actions,
7 and the concept of intention could be designed
8 to fulfill this purpose. The fact that intentions do
9 a good job of explaining actions does not there-
10 fore constitute evidence that they are a bona fide
11 mental state.

12 The content argument suggests the content
13 of the intention ("I will raise my arm") is some-
14 how linked to the specific details of the arm-
15 raising action. This view makes clearer
16 predictions about what might constitute an
17 intention. For example, if I perform two differ-
18 ent actions, raising my left arm on one occasion
19 and my right arm on another, the intentions for
20 each action should have different contents, capa-
21 ble of explaining which arm is used for the action
22 in each case. The content of intention should be
23 discriminative, in the sense that it should predict
24 specific details of action. The content argument
25 emphasizes the continuity between decision and
26 intention: when someone decides to do A rather
27 than B, they may develop an intention whose
28 specific content will relate to A rather than to B.
29 A number of neuroscientific studies have
30 attempted to decode the brain processes predict-
31 ing the specific content of a subsequent action
32 (Soon, Brass, Heinze, & Haynes, 2008; Haggard
33 & Eimer, 1999). This level of motor content
34 would typically be generated once the specific
35 situation and context of action are established,
36 and only immediately before action initiation.
37 Because intention, viewed in this way, is very
38 close to the details of motor execution, we use
39 the term "immediate intention" to refer to it.

40 Interestingly, although Libet's work (Libet,
41 Gleason, Wright, & Pearl, 1983) occupies a cen-
42 tral role in modern scientific work on intention,
43 he himself appeared to avoid the word. On the
44 one hand, he speaks of the "unconscious initia-
45 tion" of action. This refers to the set of brain
46 processes that ultimately give rise to muscular
47 movement. The readiness potential generated by
48 the frontal motor areas of the brain is a conve-
49 nient marker that these processes have begun,

but Libet avoids making the simplistic claim that
the onset of the readiness potential simply
constitutes initiation. On the other hand, the
conscious experience of immediate intention (W
judgment) occurs several hundred milliseconds
after the readiness potential onset, and only
slightly before movement itself. If the W judgment
is taken as the marker of conscious intention,
then, our conscious intentions cannot be the
cause or explanation of our actions, because
intention follows neural initiation of action,
rather than precedes it.

But is the W judgment really a marker of
immediate conscious intention? Libet himself
speaks of an "urge to act." Participants are
supposed to report the moment when this urge
begins. This is clearly one of the weaker points of
the experimental method. How do participants
know what they are supposed to report? Could
the instruction to report urges somehow suggest
to the subject that they should have a specific
experience of immediate intention that would
otherwise remain unconscious? Could the
instruction suggest to subjects the need to report
a moment slightly before action, even if they
have no distinctive conscious experience at that
moment? Participants might interpret the
instructions in such experiments as "Behave as if
you had free will, and make your reports of
intention consistent with this concept of free
will." If this were the case, then such experiments
could not separate the influence of folk psychol-
ogy from any genuine mental state of intention,
making them vulnerable to skeptical attack, or
even scientifically worthless.

EVIDENCE FROM DIRECT CORTICAL STIMULATION

Clearly, experimental manipulations of inten-
tion that do not depend on instructions, and
therefore avoid the worst problems of sugges-
tion, are highly desirable. Perhaps the most
informative data come from reports of direct
cortical stimulation prior to neurosurgery for
epilepsy. Methodologically, these data clearly
differ from psychological experiments relying on
participants' understanding of instructions. In
fact, no instruction is given at all: the patient's

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35-36, below.

1 behavior during stimulation is observed, and
 2 they are invited to report anything that they feel.
 3 Little detail is generally given about *how* the
 4 reporting is done. Few neurosurgical studies
 5 seem to address the problems of experimenter-
 6 led suggestion and response bias, for example,
 7 by including catch trials without stimulation.
 8 Nevertheless, these data have particular signifi-
 9 cance for the psychology of intention, and are
 10 therefore worth examining in some detail.

11 Direct stimulation data broadly support a
 12 distinction between initiation of action and con-
 13 scious immediate intention. In particular,
 14 we shall argue that direct stimulation of the
 15 presupplementary motor area (preSMA) is
 16 accompanied by an anticipatory conscious expe-
 17 rience of immediate intention. In contrast, direct
 18 stimulation of the deeper cingulate motor area
 19 (CMA) produces a strong *motivation* to perform
 20 a specific action, and can trigger action initiation,
 21 but without any particular *specific* conscious
 22 experience prior to action. In the neurosurgical
 23 literature, and in Libet's work also, the word
 24 "urge" is widely used. We argue that the same
 25 word is used with two quite different meanings,
 26 which have been unnecessarily confounded.
 27 On the one hand, an urge involves a conscious
 28 experience of being about to act. On the other
 29 hand, an urge involves a feeling of compulsion,
 30 or having to. We suggest these two components
 31 are localized to the preSMA and the CMA respec-
 32 tively. Rather than the general term "urge" we
 33 suggest that the terms immediate intention and
 34 motivation to act might be more appropriate.

35 Pre-SMA Stimulation Can Evoke a State 36 Resembling Immediate Intention

37 The awake patient reports a subjective experi-
 38 ence or "urge to move" during stimulation of
 39 characteristic cortical regions, notably the sup-
 40plementary motor area. The study closest to our
 41 interest is that by Fried et al. (1991). The paper
 42 reports responses to stimulation through intrac-
 43ranial grids over the mesial frontal cortex. In one
 44 patient, several reports of "urge" were obtained
 45 following low-amplitude stimulation over the
 46 supplementary motor area. The responses
 47 typically referred to a specific contralateral
 48 body part, as in "urge to move the right elbow."

In some trials, different verbal formulas appear: 49
 "need to move," "feeling as if movement were 50
 about to occur." At higher stimulation intensi- 51
 ties, actual movements were often evoked. 52
 The authors comment that the actual movement 53
 evoked was not necessarily commensurate with 54
 the urge. However, urge and movement at least 55
 referred to the same limb in the majority of trials 56
 reported for this patient. 57

The ability to evoke by external intervention 58
 a mental state that appears close to conscious 59
 intention is intriguing. However, several impor- 60
 tant methodological questions remain. How 61
 general are these sensations: they receive promi- 62
 nent attention in the report of one case, but it is 63
 unclear whether they were investigated and 64
 found to be absent, or merely not investigated, 65
 in the remaining cases? What phenomenal expe- 66
 rience does the stimulation cause? Beyond the 67
 frequent use of the word "urge" there is little 68
 information on phenomenology. One particular 69
 concern would be whether the experience 70
 reported as "urge" is truly an anticipatory expe- 71
 rience of central origin, and occurring in advance 72
 of movement. Could "urge" actually reflect 73
 subtle muscle contractions caused by low- 74
 intensity stimulation, which lacked the strength 75
 required to produce observable movement? 76
 Alternatively, could "urge" reflect a sensory 77
 experience, like the "tingling" sensation fre- 78
 quently reported following stimulation at sites 79
 close to those provoking "urge" (Fried et al, 80
 1991)? The preSMA is known to receive sensory 81
 afferent input, probably after initial processing 82
 in somatosensory cortical areas (Mima et al, 83
 1999). In conditions such as Tourette's syn- 84
 drome and restless legs syndrome, the urge to 85
 move is strongly associated with, or is simply 86
 described as, a *sensory* quality localized in 87
 specific body parts, and relieved by movement of 88
 those body parts. If urges were essentially 89
 sensory in nature, they clearly would not be a 90
 good model for conscious intention. Interestingly, 91
 however, a recent review of a series of 52 patients 92
 who underwent electrical stimulation suggests 93
 sensory experiences are not a normal feature of 94
 preSMA stimulation, being recorded in only a 95
 single instance (Chassagnon, Minotti, Kremer, 96
 Hoffmann, & Kahane, 2008). In fact, they were 97

1 much more common following stimulation of
 2 the posterior portion of the CMA. It seems likely
 3 that preSMA stimulation produces a specific
 4 conscious experience, distinct from both stimu-
 5 lation-evoked sensation and from peripheral
 6 sensation. This experience, like immediate inten-
 7 tion, is motorically specific, and linked to an
 8 impending action.

9 **CMA Stimulation Produces Motivated but** 10 **Automatized Actions**

11 In fact, the stimulation of the CMA, and particu-
 12 larly of the region of the cingulate sulcus
 13 immediately below the preSMA, seems to corre-
 14 spond more closely to Libet's "unconscious
 15 initiation of a . . . voluntary act." Chassagnon
 16 et al. (2008) report four instances where CMA
 17 stimulation elicited reaching and grasping
 18 behaviors, "as if the patients were groping
 19 around and handling a small object in the dark."
 20 There is no specific report or evidence of urge
 21 *prior* to actual movement. An extended report of
 22 one patient in this series (Kremer, Chassagnon,
 23 Hoffmann, Benabid, & Kahane, 2001) shows
 24 that these behaviors had a compulsive, irresist-
 25 ible quality. This patient had a strong drive to
 26 perform the movement once stimulation began,
 27 making scanning eye movements and explor-
 28 atory arm movements to identify a potential
 29 target for grasping. The patient is described as
 30 having an "urge to grasp something." However,
 31 it remains hard to locate this feeling of urge
 32 within the chain of events linked to the action. In
 33 particular, no quantitative data is given on two
 34 details that are of primary importance for the
 35 psychology of intention: the delay between stimu-
 36 lation onset and movement onset, and the delay
 37 between stimulation onset and any sense of
 38 "urge." We suggest that this patient showed
 39 "urge" in the motivational sense during CMA
 40 stimulation, but they did not experience the kind
 41 of anticipatory conscious awareness characteristic
 42 of immediate intentions.

43 A more extensive study of actions evoked by
 44 CMA stimulation in 83 epileptic patients was
 45 reported by Bancaud, Talairach, Geier, Bonis,
 46 Trottier, and Manrique (1976). Stimulation gen-
 47 erally produced an increased state of arousal and
 48 attentiveness, often at low stimulation intensities.

This was interpreted as a nonspecific form of 49
 attention to action. At higher stimulation inten- 50
 sities, a range of coordinated manual, buccal, and 51
 oculomotor actions were produced. Interest- 52
 53 ingly, if an object were given to the participant
 during stimulation, it would evoke complex 54
 series of object-appropriate movements. For 55
 example, when one patient was given a cigarette, 56
 they lit and smoked it in a compulsive manner, 57
 stopping smoking when stimulation ceased, and 58
 restarting when stimulation restarted. In other 59
 cases, patients compulsively ate food they were 60
 offered, or brought objects to the mouth and 61
 sucked them. Again, ceasing stimulation caused 62
 the action to end. When the experimenters phys- 63
 64 ically restrained the patient's arms, the patient
 often strove to continue the action, especially 65
 at greater stimulation intensities. This sustained 66
 drive to achieve the action is not merely a 67
 matter of maintaining motor output in the 68
 face of perturbation, since in one case the 69
 patient transferred an object repeatedly be- 70
 tween the hands to overcome the experimenter's 71
 interference. 72

73 What did the patients experience? While
 Bancaud et al. do not address this point system- 74
 atically, the general attitude of the patients 75
 toward their own evoked actions appeared indif- 76
 ferent. Patients acknowledged the action they 77
 had performed immediately afterward, but did 78
 not generally give specific reasons why they 79
 performed it, nor did they appear surprised by 80
 actions that might *prima facie* seem strange. 81
 On questioning the next day, the patients did 82
 not find their actions under stimulation in any 83
 way surprising or unusual. One way of interpret- 84
 ing this unusual phenomenology of action would 85
 suggest that the CMA drives actions, without 86
 any reference to conscious intentions, desires, or 87
 reasons for action. For example, a patient 88
 presented with a fruit in the absence of stimula- 89
 tion would merely hold it. But once stimulated, 90
 the patient would grasp and eat the fruit for as 91
 long as the stimulation lasted. This compulsive 92
 eating was not part of a normal desire for food, 93
 since it ceased with the end of stimulation. 94

95 In summary, CMA stimulation transiently
 induced a syndrome similar to utilization behavior 96
 (Lhermitte, 1983). The overall impression is of a 97

1 CMA role in motivating and driving behavior,
 2 but not in anticipating, or monitoring or adjusting
 3 it to circumstances, nor in providing a conscious
 4 experience of an impending action. The state
 5 evoked by CMA stimulation therefore appears to
 6 be closer to a motivational drive than to an
 7 intentional decision. The evoked actions appear
 8 to happen **to** the patient, but are quite decoupled
 9 from their conscious mental life, and play no
 10 role in it. This explains why the patient does not
 11 produce convincing or detailed reasons to
 12 explain why they occurred.

13 **A Model of Frontal Contributions to** 14 **Intentional Action**

15 One simple model, which could encompass Libet
 16 et al.'s (1983) concept of conscious intention, is
 17 shown in Figure 7.1. Selection between competing
 18 alternative actions that are currently available
 19 might occur in dorsolateral prefrontal cortex
 20 (DLPFC) (Rowe, Toni, Josephs, Frackowiak, &
 21 Passingham, 2000). This process may involve
 22 conscious thought about the range of action
 23 alternatives, but only at the level of abstract
 24 action possibilities. The DLPFC selects the
 25 appropriate action, and forwards the decision to
 26 two separate cortical motor areas to implement
 27 it. On the one hand the decision is sent to the
 28 CMA, which provides a motivational drive to

29 initiate the action. On the other hand the
 30 decision is sent to the preSMA, which provides a
 31 stage of flexible, contextual modulation of inter-
 32 nally generated action, weaving the selected
 33 action into the ongoing flow of behavior and
 34 experience. This flexibility is required since a
 35 behavior may be appropriate in one context but
 36 not in another: even a strongly motivated action
 37 can and should sometimes be stopped or delayed.
 38 PreSMA therefore provides contextual arbitra-
 39 tion, according to which a drive may be devel-
 40 oped into an impending action plan, or
 41 alternatively inhibited. This contextualizing role
 42 of preSMA can explain three specific findings
 43 from the neurophysiological literature that may
 44 otherwise be hard to explain (see Haggard, 2008,
 45 for a detailed review). First, cells in the preSMA
 46 appear to play a key role in integrating single
 47 actions into coordinated superordinate
 48 sequences of behavior. Second, lesions in this
 49 area produce compulsive action tendencies,
 50 reminiscent of the automatized reaching and
 51 grasping evoked by CMA stimulation. Third, the
 52 preSMA plays a key role in arbitrating involving
 53 conflict between the various alternative actions
 54 that could be consistent with a given situation.
 55 The preSMA is therefore involved not in the raw
 56 drive to action, but in reconciling action drives
 57 with current contexts.

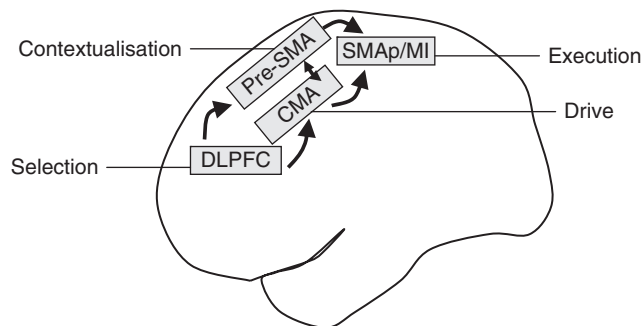


Figure 7.1 A simple model of the division of labor between frontal cortical areas in the initiation of intentional action. Selection between alternative action plans occurs in the dorsolateral prefrontal cortex (DLPFC). The signal corresponding to the selected action is forwarded along two major neural pathways: to the cingulate motor area (CMA) to provide a motivated drive to perform the action, and to the presupplementary motor area (preSMA) to modulate the action according to current context, competing action representations, etc. Hypothesized interactions provide an arbitration between the push from drive and the constraints provided by context. Both areas have access to the main motor execution pathway via supplementary motor area proper (SMAp) and the primary motor cortex (M1).

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1 Interestingly, the conscious experience of
 2 immediate intention seems to involve the same
 3 circuits that contextually constrain action drives.
 4 The conscious “urge” evoked by preSMA stimu-
 5 lation, which perhaps underlies judgments of
 6 intention in Libet-type experiments, would
 7 correspond to the moment of opening the gate
 8 between drive and motor action. The preSMA
 9 would then pass the contextualized action plan to
 10 the SMA-proper (SMAp), M1, and possibly CMA
 11 for execution. On this model, Libet is absolutely
 12 right that our actions are initiated unconsciously,
 13 by the normal functioning of the sensory and
 14 motor network of the cortex. The conscious expe-
 15 rience of immediate intention occurs when the
 16 prefrontal executive opens the gates between this
 17 network and motor executive areas, such as M1,
 18 so that the drive built up within this network can
 19 now proceed to appropriate action execution.

20 What Are Immediate Intentions?

21 The discussion above allows us to revisit our ques-
 22 tion, “what are immediate intentions?” From a
 23 neural point of view, immediate intentions are
 24 conscious experiences of impending action, gen-
 25 erated by the motor systems of the medial frontal
 26 cortex. From a psychological point of view, two
 27 important aspects of immediate intention are
 28 worth emphasizing. First, immediate intentions
 29 are predictive, in the sense that they precede
 30 actions. Second, immediate intentions have an
 31 episodic, time-locked quality, rather than being
 32 abstract and semantic. Thus, the content of an
 33 immediate intention prefigures at least some of
 34 the specific motor details of the action itself.
 35 Immediate intentions are not linked to actions in
 36 a vague and general way, but in a motor-specific
 37 way (Haggard & Eimer, 1999), even in artificial
 38 cases such as preSMA stimulation (Fried et al,
 39 1991). Put another way, immediate intentions
 40 incorporate the specific contextual detail, corre-
 41 sponding at least to the P-level and often to the
 42 M-level in the DPM hierarchy. An interesting con-
 43 scious correlate of this episodic quality is the very
 44 integrated experience we have of our own volun-
 45 tary action. Intention, action, and goal are not
 46 experienced as separate disconnected events, but
 47 as a tight and integrated flow. In particular, inten-
 48 tional actions, but not involuntary movements,

display an effect called “intentional binding,” 49
 whereby the experiences of action and effect are 50
 perceived as temporally compressed and bound 51
 together (Haggard et al, 2002; Haggard & Cole, 52
 2007), as if part of a single episode. 53

2. PROSPECTIVE INTENTIONS

54

We share with other animals the capacity to act 55
 purposefully, but we also regularly make more or 56
 less complex plans for the future, and our later 57
 conduct is guided by these plans. We are, in 58
 Michael Bratman’s words, planning agents, and 59
 this planning ability appears to be distinctively 60
 human. People can, and frequently do, form 61
 intentions focused on actions that may occur years 62
 or even decades later. Intentions to choose par- 63
 ticular careers, to become prime minister, or to 64
 choose a destination for next year’s holiday all 65
 offer examples. The length of time-scale associ- 66
 ated with prospective intentions is virtually unlim- 67
 ited. These long-range intentions appear to be 68
 effectively connected with short-range intentions, 69
 and therefore with action itself. General intentions 70
 formed at one time-point cascade into much more 71
 detailed intentions prior to action execution. 72

However, almost nothing is known about 73
 how these long-range, prospective intentions 74
 connect to immediate, short-term intentions. 75
 Indeed, experimental studies of voluntary action 76
 deal hardly at all with the concept of prospective 77
 intention. On one view, the prospective inten- 78
 tion in such studies consists in the participant’s 79
 decision to participate in the experiment in the 80
 first place, and thus lies beyond what can be 81
 measured in the experimental setting itself. 82

We start this section with a brief review of 83
 Bratman’s influential account of prospective 84
 intentions (or as he calls them future-directed 85
 intentions), what their main characteristics are, 86
 and what makes it useful to have them. We then 87
 turn to the issue what kind of cognitive processes 88
 are involved in the formation of prospective 89
 intentions and how these relate to the processes 90
 involved in immediate intentions. 91

Bratman on Intentions

92

Bratman’s account of future-directed intentions 93
 (Bratman, 1987) stresses the commitment to 94

1 action that is a distinctive characteristic of inten-
 2 tions. When I intend today to go Christmas
 3 shopping tomorrow, I do not simply want or
 4 desire today that I go Christmas shopping
 5 tomorrow. Rather I am committed now to going
 6 shopping tomorrow. What exactly does this
 7 commitment involve? Bratman distinguishes
 8 two dimensions of a commitment to action:
 9 a volitional dimension and a reasoning-centered
 10 dimension. The volitional dimension concerns
 11 the relation of intention to action and can be
 12 characterized by saying that, “intentions are,
 13 whereas ordinary desires are not, conduct-
 14 *controlling* pro-attitudes. Ordinary desires, in
 15 contrast, are merely *potential influencers* of
 16 action” (1987, p. 16). In other words, unless
 17 something unexpected arrives that forces me to
 18 revise my intention, my intention today to go
 19 shopping tomorrow will control my conduct
 20 tomorrow. The reasoning-centered dimension
 21 of commitment is most directly linked to
 22 planning. At stake here are the roles played by
 23 intentions in the period between their initial for-
 24 mation and their eventual execution. First,
 25 intentions have what Bratman calls a character-
 26 istic *stability* or inertia: once we have formed an
 27 intention to *A*, we will not normally continue to
 28 deliberate whether to *A* or not. In the absence of
 29 relevant new information, the intention will
 30 resist reconsideration, we will see the matter as
 31 settled and continue to so intend until the time
 32 of action. Intentions are thus *terminators of*
 33 *practical reasoning* about ends or goals. Second,
 34 during this period between the formation of an
 35 intention and action, we will frequently reason
 36 from such an intention to further intentions,
 37 reasoning from instance from intended ends to
 38 intended means or preliminary steps. When we
 39 first form an intention, our plans are typically
 40 only partial, but if they are to eventuate into
 41 action, they will need to be filled in. Thus, inten-
 42 tions are also *prompters of practical reasoning*
 43 about means. Finally, the volitional and reason-
 44 ing-centered dimensions of intentions together
 45 account for another important function of
 46 prospective intentions, namely their role in sup-
 47 porting both *intrapersonal and interpersonal*
 48 *coordination*. Because intentions have stability,
 49 are conduct-controlling, and prompt reasoning

about means, they support the expectation that 50
 I will do tomorrow what I intend today to do 51
 tomorrow. Such expectations facilitate coordi- 52
 nation. My intention to go Christmas shopping 53
 tomorrow supports my sister’s expectation that 54
 I will, and she can go ahead and plan to join me 55
 in this shopping expedition. Similarly, I can 56
 go ahead and plan my activities for the day 57
 after tomorrow, on the assumption that by 58
 tomorrow evening I will be done with Christmas 59
 shopping. 60

As noted by Bratman himself, future-directed 61
 intentions have an air of paradox. They are typi- 62
 cally stable but they are not irrevocable. Such 63
 irrevocability would be irrational, since things 64
 can change and our anticipation of the future is 65
 not infallible. This suggests that, having formed 66
 today an intention to do something tomorrow, 67
 I should persist in that intention tomorrow only 68
 if it would then be rational for me to form such 69
 an intention from scratch. But then, asks Bratman, 70
 why **I** should I bother deciding today what to do 71
 tomorrow? Isn’t that just a waste of time? 72

Delete "I"

Bratman offers several complementary 73
 answers to that challenge. They stem from the 74
 fact that we are epistemically limited creatures, 75
 with limited cognitive and time resources for use 76
 in attending to problems, gathering informa- 77
 tion, deliberating about options, determining 78
 likely consequences, and so on. There are several 79
 reasons our epistemic limitations make it useful 80
 for us to form prospective intentions. First, if 81
 our actions were influenced by deliberation only 82
 at the time of action, this influence would be 83
 minimal, as time pressure isn’t conducive to 84
 careful deliberation. Advance planning frees us 85
 from that time pressure and allows us to deploy 86
 the cognitive resources needed for successful 87
 deliberation. Second, intentions once formed 88
 have characteristic stability. They resist recon- 89
 sideration. This doesn’t mean we never reconsider. 90
 Intentions may be revoked. But as Bratman 91
 points out, revocability does not entail actual 92
 reconsideration. Unless new facts come to light, 93
 we will normally simply retain our intentions. 94
 Furthermore, in settling on a course of action, 95
 we have already rehearsed and weighted the con- 96
 siderations for and against that course of action. 97
 This prior rehearsal puts us in a better position 98

1 to assess whether a new piece of information is
 2 actually relevant or not to our plans. If nonre-
 3 consideration is the default option, once an
 4 intention is formed the precious cognitive
 5 resources that were engaged in deliberation
 6 ends are **free** be used for other tasks,
 7 including planning about means and ensuring
 8 both intra- and interpersonal coordination.
 9 To achieve complex goals, I must coordinate my
 10 present and future activities and coordinate with
 11 activities of other agents. If I now intend to go to
 12 the concert tomorrow night, I first need to pro-
 13 cure a ticket and make sure I have a babysitter
 14 for the evening. If I were to leave it to the last
 15 minute to decide whether I go to concert tonight
 16 or not, I may well be frustrated to find out that
 17 tickets are sold out or that the babysitter is not
 18 available. Thus, the success of many of our
 19 actions depends on our ability to coordinate our
 20 own activities over time and to coordinate them
 21 with the activities of other agents. This coordi-
 22 nation is best achieved if we plan ahead of time.
 23 So-called Buridan cases provide a third reason
 24 for forming intentions. We may be forced to
 25 choose between options that we find equally
 26 desirable. I may have an equal desire to go to a
 27 concert or to go see a play tomorrow evening.
 28 But if I am to do either, I had better decide now
 29 among these options. For one thing, it may not
 30 be worth my while looking for further informa-
 31 tion in the hope of finding new reasons to decide
 32 between them, as the effort and time needed to
 33 gather further information may well exceed the
 34 potential benefits of, say, enjoying the concert
 35 slightly more than I would have the play.
 36 Moreover, once again, intrapersonal and inter-
 37 personal coordination require that I reach a deci-
 38 sion. I need to know whether to buy a ticket for
 39 the play or for the concert, and if I wish friends to
 40 join me, I need to let them know whether I intend
 41 to go to the concert or to go see the play.

42 **Future-Oriented Cognition and Mental** 43 **Time Travel**

44 Prima facie, it would seem that the reasons that
 45 make it useful for us to form prospective inten-
 46 tions also apply to other species. Limited cogni-
 47 tive resources and a need for coordination are
 48 not unique to humans. So why is it that we alone

appear to exhibit such distinctive planning 49
 abilities? One obvious answer is that other species 50
 are even more limited **then** we are in their cogni- 51
 tive resources; a complementary answer is that 52
 how much need and use we have for planning 53
 also depends on the kind of environment we live 54
 in. There wouldn't be much use for planning in 55
 an environment that were completely unpredict- 56
 able, for planning exploits regularities and in 57
 such an environment there would be none to 58
 exploit. On the other hand, in an environment 59
 both simple and reasonably predictable, there 60
 may be cheaper ways of coping than those 61
 involving advance planning. Suddendorf and 62
 Corballis, (2007) describe several ways in which 63
 behavior may be future-oriented without involv- 64
 ing a capacity to think about the future as such. 65
 First, future-directed behavior may be instinc- 66
 tual, as when, through natural selection, a species 67
 has evolved behavioral predispositions to exploit 68
 significant long-term regularities. For instance, 69
 an animal can gather food for hibernation, 70
 although it has yet to experience a winter. 71
 Second, future-directed behavior may be driven 72
 by procedural learning, allowing an individual to 73
 track short-term regularities. For instance, 74
 through association, a conditioned stimulus can 75
 predict the future arrival of an unconditioned 76
 response and trigger a future-directed response. 77
 Third, future-directed behavior may exploit 78
 semantic memory about regularities, which 79
 provides the basis for inferential and analogical 80
 reasoning and allows learning in one context to 81
 be voluntarily transferred to another. Procedural 82
 learning allows for greater flexibility than instinc- 83
 tual patterns of behavior, allowing behavior to 84
 be modulated by individual experience; seman- 85
 tic memories provide even greater behavioral 86
 flexibility as they can be triggered endogenously 87
 rather than being stimulus bound. Yet, the envi- 88
 ronment in which humans live is unique in both 89
 its ecological and its social complexity. Humans 90
 also have an extraordinary range of desires and 91
 motivations, going far beyond the basic drives 92
 and simpler desires present in other species. 93
 Dealing with this spectacular environmental, 94
 social, and motivational complexity may require 95
 in turn forms of future-oriented cognition that 96
 exhibit unique flexibility and versatility. 97

Insert to "free to
be"

replace
then with
than

1 A prime candidate for this more flexible form
 2 of future-oriented cognition is *mental time*
 3 *travel*, the faculty that allows a person to men-
 4 tally project herself backward in time to relive
 5 past events or forward to pre-live events
 6 (Suddendorf & Corballis, 1997, 2007; Suddendorf
 7 & Busby, 2003, 2005; Wheeler, Stuss, & Tulving,
 8 1997). Mental travel in the past, known as epi-
 9 sodic memory, has been intensively studied (e.g.,
 10 Tulving, 1983, 2005). Mental travel into the
 11 future, in contrast, has only recently begun to
 12 draw attention. Recent work indicates that
 13 mental travel into the past and into the future
 14 are closely related, involving similar cognitive
 15 processes—a combination of episodic memory
 16 and imagination under executive control—and
 17 recruiting strongly overlapping neural systems
 18 (D'Argembeau & Van der Linden, 2006;
 19 Hassabis, Vann, & Magurie, 2007; Klein, 2002;
 20 Gerrans, 2007). Several researchers have argued
 21 that mental time travel into the future is a crucial
 22 cognitive adaptation, enhancing planning and
 23 deliberation by allowing a subject to mentally
 24 simulate and evaluate contingencies, and thus
 25 enhancing fitness, and that mental time travel
 26 into the past is subsidiary to our ability to imag-
 27 ine future scenarios (Dudai & Carruthers, 2005;
 28 Suddendorf & Corballis, 2007).

29 Mental time travel, whether into the past
 30 or into the future, involves episodic memory
 31 and inherits its two main characteristics. First, it
 32 is not about regularities but about constructing
 33 or reconstructing the *particularities of specific*
 34 *events*. Second, mental time travel involves
 35 *autonoesis*, i.e., awareness of a self as the subject
 36 of actual, recalled, or imagined experience. But
 37 what are exactly the benefits that accrue from
 38 using mental time travel rather than simply
 39 reasoning from general knowledge stored in
 40 semantic memory in planning future actions?
 41 As we have seen, prospective intentions involve
 42 making a number of decisions. The intention
 43 is first formed when one reaches a decision about
 44 what to do. Once the intention is formed,
 45 one must still typically make a number of
 46 decisions about how to implement the chosen
 47 goal. Another important decision, not explicitly
 48 considered by Bratman, concerns when to
 49 act. What can mental time travel contribute to

these what-decisions, how-decisions, and when- 50
 decisions? 51

What-decisions 52

Not all what-decisions involve explicit conscious 53
 deliberation. Some decisions are pretty straight- 54
 forward. If my closest friend invites me to her 55
 wedding, of course I'll accept the invitation and 56
 form the intention to attend the wedding. 57
 If, however, being on the job market, I am offered 58
 academic positions in two different universities, 59
 I might spend quite a while weighing the pros 60
 and cons of each option before reaching a deci- 61
 sion. Yet, it may be that performing a logical 62
 cost-benefit analysis of the two options does not 63
 suffice to motivate me to choose one over the 64
 other, even if this analysis yields a clear advan- 65
 tage for one of the options. Rather, I might have 66
 to imaginatively rehearse future experiences 67
 occupying one or the other position as part of 68
 the process of deliberation. 69

Patients with damage to the ventromedial 70
 prefrontal cortex (VMPFC) are often described 71
 as having impaired ability for planning and 72
 decision-making despite retaining intact capaci- 73
 ties for explicit reasoning. Philip Gerrans, (2007) 74
 argues that this impairment is best explained by 75
 a deficit in mental time travel. In his view, 76

Damasio's somatic marker hypothesis (Dama- 77
 Tranel, & Damasio, 1991; Bechara, Dama- 78
 Damasio, & Lee, 1999), according to which the 79
 deficits of VMPFC patients result from a failure 80
 to link an implicit emotional response—a 81
 somatic marker—with an explicit representation 82
 of a situation, is deficient in two ways. First, it 83
 uses an account of emotions that explains 84
 salience and motivation in terms of valence and 85
 within this framework interprets somatic markers 86
 as valencing systems whose activation is required 87
 to produce suitable motivation. However, recent 88
 research shows that the mechanisms that make 89
 objects salient and motivate behavior are inde- 90
 pendent neurally and cognitively from those that 91
 determine valence. The mesolimbic dopamine 92
 system plays a central role in salience/motivation 93
 by predicting reward (rather than valence), while 94
 valencing appears to be realized by a number of 95
 other systems, including the opioid and benzo- 96
 diazepine systems (Berridge & Robinson, 2003; 97

Delete comma
 "Gerrans"

WHAT ARE INTENTIONS?

79

1 Berridge, 2007; Robinson & Berridge, 2003).
 2 Second, the somatic marker hypothesis under-
 3 specifies the nature of the explicit representa-
 4 tions involved in decision-making. These
 5 representations can either be declarative, as
 6 when one performs cost-benefit analysis by
 7 manipulating probabilities, or episodic, as when
 8 one uses past experiences to imagine future ones.
 9 According to Gerrans then, the planning and
 10 decision-making deficits of VMPFC patients
 11 result not so much from their inability to associ-
 12 ate semantic markers to their explicit declarative
 13 representations as from their inability to
 14 perform mental time travel, that is to imagine
 15 themselves living out future scenarios and thus
 16 activating the motivationally relevant contin-
 17 gencies salient in these imagined experiences.

18 If this conception of the link between mental
 19 time travel and motivation is on the right track,
 20 mental time travel could also help explain one
 21 unique characteristic of human planning.
 22 According to the Bischof-Köhler hypothesis
 23 (Bischof-Köhler, 1985; Suddendorf & Busby,
 24 2005), nonhuman animals cannot anticipate
 25 future needs or drive states. Humans, in
 26 contrast, can plan for the future not just on the
 27 basis on their current motivational states but
 28 also on the basis of what they anticipate their
 29 future motivational states to be. The ability to
 30 project oneself forward in time and imagine
 31 future scenarios may be an important key to
 32 motivation regulation.

33 **How-decisions**

34 The construction of plans for future actions
 35 depends in part on semantic memory, since it is
 36 crucial to their success that the plans we come up
 37 with be consistent with our general knowledge
 38 about the world. Yet, filling in the details of a
 39 plan may depend on our ability to imagine future
 40 episodes, since they provide the particularities
 41 that will help us fine-tune the plan to the partic-
 42 ular occasion. However, trade-offs need to be
 43 considered, since mental time travel is effortful
 44 and cognitively costly. When I form the prospec-
 45 tive intention to go to my office tomorrow rather
 46 than to work from home, there is no need for me
 47 to mentally rehearse the route to my office.
 48 The route is familiar enough that I can trust

myself to do the right thing when the time comes. 49
 Suppose, however, that I have an appointment 50
 tomorrow in some other part of the city I am less 51
 familiar with. In that case, it may be worthwhile 52
 rehearsing possible ways of getting there and 53
 using memories of past episodes to decide 54
 between options. For instance, I may remember 55
 that changing lines at this station takes forever 56
 and involves walking along endless, badly lit, 57
 corridors, or I may remember getting stuck in 58
 heavy traffic on a given bus line. Or imagine 59
 again, I am about to visit Beijing for the first time 60
 and have no clue what the public transportation 61
 is like there. In such a case it may be a waste of 62
 time and energy imagining potential future 63
 scenarios for how to get around in Beijing. 64
 The scenarios I come up with may be far off the 65
 mark and completely useless in the end; better 66
 just way and see. 67

More generally, whether we make how- 68
 decisions early or late and the extent to which we 69
 use mental time travel to make those decisions 70
 depends on a number of factors, among them: 71
 how predictable we think the future situation is; 72
 how knowledgeable we are; whether our knowl- 73
 edge is mostly declarative or based on prior 74
 personal experience; how motivated we are 75
 (as rehearsing a future scenario may help rein- 76
 force motivation); how novel or difficult the 77
 prospective action is; how neurotic our person- 78
 ality is. In addition, there appear to be important 79
 individual differences in the ability to project 80
 oneself into possible future events. A recent 81
 study (D'Argembeau & Van der Linden, 2006) 82
 provides evidence that the individual differences 83
 in dimensions known to affect memory for past 84
 events similarly influence the experience of 85
 projecting oneself into the future. People less 86
 adept at recalling in vivid detail past episodes of 87
 their life, are also less able to simulate specific 88
 future events. Note that these results also 89
 provide support for the view that mental time 90
 travel into the past and mental time travel into 91
 the future rely on similar mechanisms. 92

When-decisions 93

A prospective intention is an intention to perform 94
 an action at some future time. But if the intention 95
 is to eventuate into action, it is important that the 96

1 time of action be specified. An initial when-
 2 decision can take at least two forms. The time of
 3 action can be specified in explicit temporal
 4 fashion, say as “next Tuesday” or “on the first of
 5 November” or it can be specified in relation to
 6 some specific future event, say “when I next meet
 7 Charles” or “as soon as the bell rings.” Work in
 8 the field of prospective memory sheds light on
 9 interesting differences between the time-based
 10 and the event-based strategies.

11 Prospective memory is a field of cognitive
 12 psychology dealing with remembering to
 13 perform an action in the future (e.g., I must
 14 remember to stop to buy fruit on my way home
 15 from work). The starting point for prospective
 16 memory is clearly an intention to perform an
 17 action at a future time. Most experimental studies
 18 deal with event-based prospective memory, in
 19 which a specific event that will occur in the
 20 future is used as a cue for an action. Translating
 21 a long-range intention into action then becomes
 22 a matter of identifying that the cue has occurred,
 23 and retrieving the appropriate action in response
 24 to it. Several studies of “implementation inten-
 25 tions” in applied psychology (Gollwitzer, 1999),
 26 suggest this strategy is effective: intended actions
 27 such as taking medication are more likely to
 28 occur if people link their implementation to a
 29 specific external event. According to Gollwitzer,
 30 (1999), what explains the efficacy of implemen-
 31 tation intentions is the fact that their formation
 32 triggers two sets of processes. First, when an
 33 implementation intention is formed, mental
 34 representations of the relevant situational cues
 35 become highly activated, leading to heightened
 36 accessibility, and thus a better detection, of these
 37 cues when they are encountered (Aarts,
 38 Dijksterhuis, & Midden, 1999; Gollwitzer, 1999;
 39 Webb & Sheeran, 2007). Second, implementa-
 40 tion intention formation not only enhances the
 41 accessibility of the specified situational cue,
 42 but also forges an association between that cue
 43 and a response that is instrumental for obtaining
 44 one’s goal, thus making action initiation more
 45 immediate and efficient.

46 Such “implementation intentions” may take
 47 advantage of the fact that externally cued inten-
 48 tions are normally more strongly held, in the
 49 sense of being harder to overturn, than internally

generated intentions (Fleming, Mars, Gladwin, 50
 & Haggard, 2009). 51

Prospective memory can also be time-based, 52
 rather than event-based. In time-based prospec- 53
 tive memory, an intended action is performed at 54
 a designated future time, without any particular 55
 cue event occurring at that time. Thus, time- 56
 based prospective memory seems to be purely 57
 endogenous, while event-based prospective 58
 memory effectively reduces endogenous actions 59
 to cue-triggered reactions. The distinction 60
 between the two forms is supported by the 61
 dissociation between different rostral prefrontal 62
 activations in time-based and event-based 63
 prospective memory tasks (Okuda et al., 2007). 64

Recent studies of time-based prospective 65
 memory suggest an interesting role for uncon- 66
 consciously initiated processes, similar to Libet’s 67
 action initiation, in linking long-range inten- 68
 tions to eventual action. Kvavilashvili and Fisher 69
 (2007) asked participants to call an experimenter 70
 at a self-chosen time one week after an initial 71
 briefing session. In the intervening week, they 72
 noted the circumstances in which they remem- 73
 bered this intention, using a diary. Although the 74
 authors refer to these memory events as “rehears- 75
 als” they were primarily automatic and uncued 76
 events, in which the intention to make the phone 77
 call simply “popped into” the participant’s mind, 78
 without obvious cue or antecedent. The frequency 79
 of these recall events increased dramatically in 80
 the day before the phone call was due, but this 81
 increase was less dramatic in those participants 82
 who in fact failed to return the phone call on 83
 time. 84

3. LINKING PROSPECTIVE INTENTIONS TO IMMEDIATE INTENTIONS 85

86
 87
 Actions are not always the product of prospective 88
 intentions, they may often simply be the outcome 89
 of immediate intentions, formed on the spot, so 90
 to speak. But let us focus on cases where actions 91
 are preceded and brought about by prospective 92
 intentions. What is the additional contribution, 93
 if any, of immediate intentions to such actions? 94

Recall that in the section 1 we characterized 95
 the content of immediate intentions as involving 96

WHAT ARE INTENTIONS?

81

1 episodic representations. Forming an immediate
 2 intention involves fitting one's endogenous goal
 3 to the current situation, using contextual infor-
 4 mation to generate a representation of a specific
 5 episode of acting. When one has a prospective
 6 intention to perform an action, how much work
 7 there is left for an immediate intention to do
 8 at the moment of action itself will depend on
 9 how episodic the content of the prospective
 10 intention already is. This will in turn depend on
 11 the extent to which the agent made use of mental
 12 time travel in forming and shaping his prospec-
 13 tive intentions. For example, a person forming a
 14 prospective intention may become fully involved
 15 in mental time travel and may simulate the full
 16 details of how and when the action will occur.
 17 Conversely, one can have a genuine prospective
 18 intention while knowingly leaving it for later to
 19 decide on the means. At one extreme of a
 20 continuum is the "neurotic planner," at the
 21 other end is the "optimistic improviser."

22 The neurotic planner makes extensive use of
 23 mental time travel, imaginatively combining and
 24 recombining elements from prior stored
 25 episodes to generate, early on, precise scenarios
 26 concerning the action to be performed and
 27 the situation in which it is to be performed.
 28 His strategy is to generate as much episodic
 29 information as he can as early as he can. When
 30 mental time travel serves well, this front-loading
 31 strategy leaves little left for immediate intentions
 32 to do.

33 Using Gollwitzer's terminology, we can say
 34 that neurotic planners tend to make early
 35 detailed how- and when-decisions, thus forming
 36 implementation intentions. A key feature of this
 37 strategy of early planning is that it allows for
 38 later automatization. As Gollwitzer points out,
 39 implementation intentions automatize action
 40 initiation: "The goal-directed behavior specified
 41 in an implementation intention is triggered
 42 without conscious intent once the critical situa-
 43 tional context is encountered" (Gollwitzer, 1999,
 44 p. 498). Thus, the use of external cues to trigger
 45 action seems partly to shift the action from an
 46 endogenous or voluntary one to a stimulus-
 47 driven or reactive one.

48 In contrast, the optimistic improviser gener-
 49 ates little episodic information early on. She makes

a what-decision, possibly a time-based when-
 decision, but keeps her options open as to how
 and in what specific situation the action is to be
 performed. She is committed to generating rele-
 vant episodic information in real time, at the
 moment of the action itself. The prospective
 intentions of agents following this strategy con-
 tain as yet too little episodic information to yield
 action. To fill this informational gap between her
 prospective intention and action initiation, the
 agent will have to form an immediate intention
 specifying the missing information. This means
 that the agent must retain some endogenous con-
 trol over action initiation and cannot delegate it to
 automatic responses to environmental triggers.

Episodic information must be generated in
 order to produce a specific action. It can be gen-
 erated either early (neurotic planner) or later
 (optimistic improviser). These are in some sense
 alternative reciprocal responses to the common
 challenge of deciding exactly what one will do.
 Despite the personality-based labels we used,
 early versus late planning isn't just a matter of
 temperament. Each strategy may be better suited
 to some situations than to others. Early planning
 has its dangers. If the agent's anticipations were
 not correct, the external cues on which action
 initiation depends may fail to materialize. Or,
 worse perhaps, the cues may be present and
 automatically trigger the action when other
 unanticipated and unattended aspects of the
 situation make it unadvisable to pursue as
 planned. The late planner may be more flexible,
 but she risks unpreparedness when the time of
 acting comes. Having left it to the last moment
 to deliberate about means, when she finally does
 so she also risks reopening the Pandora's box of
 deliberation about ends. What-decisions and
 how-decisions aren't strictly compartmentalized.
 The costs and efforts involved in deliberating
 about how to A under time pressure, may lead
 one to reconsider whether to A in the first place,
 when giving up A-ing may well tempt us as the
 less costly option.

Often, and perhaps most of the time, our plan-
 ning strategies will be mixed strategies, taking
 into account various factors beyond mere tempera-
 ment; among them, the expected predictability of
 relevant future situations, one's store of relevant

delete s
 "intention"

"tempera
 ment"
 instead of
 temperament

1 semantic and episodic information, one's degree
2 of motivation, the degree of novelty or difficulty
3 of the planned action, and how strong one thinks
4 time constraints will be at the time of acting. The
5 generation of episodic information about future
6 actions will thus be distributed over time in vari-
7 ous ways according to our assessment of these
8 factors. One example of these differing distribu-
9 tions comes from the contrast between **an** event-
10 based and time-based prospective memory. In
11 event-based prospective memory, specific details
12 of the action episode are already present in the
13 prospective intention itself. In contrast, time-
14 based prospective memory lacks any concrete
15 details about the specific context in which the
16 action will occur. Most people can and do
17 use both forms of planning. This flexibility in
18 the temporal distribution of episodic information
19 is a fundamental dimension of the psychology
20 of intention. The skilled planner is the one
21 who knows how best to take advantage of this
22 flexibility.

23 4. CONCLUSION

24 The concept of intention can do useful work in
25 psychological theory. We have made a distinc-
26 tion between prospective and immediate inten-
27 tions. Many authors have insisted on a qualitative
28 difference between these two regarding the type
29 of content, with prospective intentions generally
30 being more abstract than immediate intentions
31 (e.g., Searle, 1983; Pacherie, 2008). However, we
32 suggest that the main basis of this distinction is
33 temporal: prospective intentions necessarily
34 occur before immediate intention and before
35 action itself, and often long before them. In con-
36 trast, immediate intentions occur in the specific
37 context of the action itself. Yet both types of
38 intention share a common purpose, namely that
39 of generating the specific information required
40 to transform an abstract representation of a goal-
41 state into a concrete episode of instrumental
42 action directed toward that goal. To this extent,
43 the content of a prospective and of an immediate
44 intention can actually be quite similar. The main
45 distinction between prospective and immediate
46 intentions becomes one of when, i.e., how early
47 on, the episodic details of an action are planned.

In our view, the conscious experience associ- 48
ated with intentional action comes from this 49
process of fleshing out intentions with episodic 50
details. In the field of episodic memory, repre- 51
sentations of episodes are thought to include an 52
autonoetic type of consciousness (Tulving, 1983). 53
We suggest that intentional actions reach con- 54
scious awareness at the point where they become 55
specific action episodes. However, the time when 56
this occurs can vary. We have argued that 57
episodic detail can be generated either as part of 58
advance planning, in the form of prospective 59
intentions, or as part of an immediate intention 60
in real time. In the former case, one might have 61
a conscious mental image of what one will do, 62
but the doing itself may be automatized and only 63
marginally conscious. In the latter case, one may 64
have a specific conscious experience linked to 65
the initiation of action, along the lines studied by 66
Libet. 67

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delete an
"between
event-
based"

WHAT ARE INTENTIONS?

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